

The following is Landauer's response to your General Specifications. We agree and will comply with all specifications except those referenced below where we Exceed, Take Exception, or Offer Clarification.

A. GENERAL SPECIFICATIONS

B. FACILITY EVALUATION AND VENDOR QUALIFICATION

1. Five years of NVLAP Proficiency Test Results Enclosed.
2. A listing of processing equipment used in processing dosimeter dose is included.
3. Facility audit reviews for some other accreditations are included.
4. Calibration standards and uncertainties studies are included.

C. FACILITY STANDARD OPERATING PROCEDURES

1. Control Dosimeters and Background Dose Assignments

- a. Landauer provides several different options for dosimeters returned without controls. First, our default would be to report all the gross results for participant dosimeters and flag the report indicating there was no control dosimeter returned.

The option would be to have Landauer turn on an automatic background subtraction. This is a daily calculation equivalent to 6mrem per month and is calculated from the day the dosimeter was produced to the day it is processed. We flag the exposure report so you can easily identify we utilized this option.

- b. We do not assume any background values. One of the unique features of Luxel+ and OSL technology is our ability to keep the detector at zero background until the day we manufacture the dosimeter. The benefit is that other technologies may have as much as 8 weeks or more of background accumulated on the dosimeter prior to it being assigned to your account. Also since Luxel+ is a single use detector, there is no chance of any residual energies being left on the detector. This is a common problem with TLD technology since the same crystals are used over and over again.
- c. As described in (A) it is a daily calculation that is assessed from the day the dosimeter is manufactured to the day it is analyzed. This calculation is equivalent to 6mrem per month.
- d. The feature of automatic background subtraction is automatically applied if you select the option and if a proper control is not returned. If a usable control is returned it will be used unless it is identified as reporting higher than the participants. In that case we flag it as defective, report the dose for the control, and use the automatic background subtraction calculation.
- e. Each dosimeter is identified with a unique serial number that identifies the date of manufacture and the account and participant it is assigned to. This serial number is used for identification throughout Landauer's processing and archiving systems.

2. Lost and Missing Dosimeters

- a We assume you are talking about a missing dosimeter as others are returned for processing. If you are referring to a missing dosimeter when they arrive at your facility, the remedy would be to call us and we would gladly replace it at no additional charge to you. Since our dosimeter production systems are automated, this occurrence should be very small. Normally it is caused by a dosimeter being added after the cut off date for the next month's dosimeters. In that case it would arrive in a separate package so long as it was ordered for rush shipment. If not indicated, it would be in the next run of dosimeters for that account and series.

Now for one missing as a group is returned for processing. Landauer offers an option called absentee reporting. If a dosimeter is missing and our default value of 70% of dosimeters are returned we would then list those missing on the exposure report with no dose data attached. The default level may be moved up or down to fit your individual needs for the account.

Another option would be to utilize Landauer's EstiMate reporting service. EstiMate, when a dosimeter is missing, averages the last 12 months exposure for that participant and fills in the estimated dose for the participant on the exposure report and flags the report so you know how the exposure was determined. If at a later date the dosimeter is returned, we would automatically overwrite the estimated dose with the measured dose. We additionally issue a supplemental report at 45 and 120 days past the estimated dose being applied. This special report allows you to see what exposures were used in determining the Estimate and gives you an opportunity to change the estimated dose to a calculated dose. If you choose to change any exposure to calculated, and then the dosimeter is returned, we would show the dose for the dosimeter but would only change the participant's accumulated exposure if you give us those instructions.

- b. A dosimeter is considered lost if not returned within 90 days past the end date the dosimeter was issued for. At that point an assessment for a lost dosimeter would be applied. If the dosimeter is found and returned after the 90 day period but before 1 year has elapsed, 50% credit is issued. If the dosimeter is returned after 1 year has elapsed no credit is issued.
- c. A damaged dosimeter is one that is damaged to the point that the filter pack inside the dosimeter cannot be used again. Examples might be, chewed by a dog, or cut in half with shears.
- d. A dosimeter can be worn past the end date the dosimeter was issued for, if Landauer is notified of the change in the end date. It should be noted that if the participant is on a regular shipping frequency, they will automatically receive a new dosimeter for the next period.

3. Dosimeter Accountability

- a. Landauer utilizes a unique serial number for each dosimeter we produce. Through this serial number we track the dosimeter itself and the account and participant it is

assigned to for that wear period. The serial number is kept in our computer system and follows the dosimeter into our archiving system after it is analyzed.

- b. There are two options. Our normal lower level of reporting is 1mrem for Luxel+ whole body dosimeters. You may also elect 10mrem reporting, however it should be noted that we would then report "SL" (Selected Level) on the exposure report since "M" (Minimal) for Landauer is now less than 1mrem.

4. Reading and Rereading Procedures

- a. OSL technology and your Luxel+ dosimeters have a unique capability that no other technology offers. We are able to completely reanalyze the dosimeter many times. The dosimeter is read at room temperature with light instead of heat. Since it is a single use dosimeter, we place it in our archives so further laboratory analysis may be performed if necessary. Film can be reread many times but if something goes wrong in the developing process it will always be wrong. TLD is a destructive process. The crystals are heated to roughly 300 degrees Celsius. All signal is destroyed in the process.
- b. As Landauer receives dosimeters back from any client they are first scanned with a low level detector to ensure there are no radioactive badges in the shipment and then they are opened and each dosimeter is scanned into our tracking system. This tracking is identifying each serial number from the master list from when the dosimeter was manufactured. From that point forward we can track the exact location of the badge as it goes through the analytical process. If there is an overexposure we will notify you roughly two days into the process to read the badge. We average 7 working days to complete the process and generate the written exposure report. Any dosimeter that is read and exceeds 500mrem is segregated and imaged to establish if it is static or dynamic. In other words was someone wearing the dosimeter at the time it was irradiated. This is helpful information if you clearly know someone was not wearing it. This process is completed and information given to you at the 2 day period as we notify you of an over exposure. After the report is generated the dosimeter is placed into archive just in case you require additional laboratory analysis.

5. Dosimeter Limitations

- a. Landauer dosimeters respond by the following:
 - Luxel+ (Type P)**
 - X-Ray/Gamma >5 keV
 >1mrem reporting
 - Beta >150 keV - \approx 10 MeV
 >10mrem reporting
 - Luxel+ (Type J)**
 - X-Ray/Gamma >5 keV
 >1mrem reporting
 - Beta >150 keV - \approx 10 MeV
 >10mrem reporting

Fast Neutron	>40 keV - \approx 40 MeV >20mrem reporting
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Luxel+ (Type T)

X-Ray/Gamma	>5 keV >1mrem reporting
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Beta	>150 keV - \approx 10 MeV >10mrem reporting
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Neutron	>0.250 eV - \approx 40 MeV >20mrem reporting
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Readings for OSL dosimetry is expected within \pm 10%

Ring (Type U)

X-Ray/Gamma	>15 keV >30mrem reporting
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Beta	>200 keV >40mrem reporting
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- b. Landauer dosimetry processing equipment is calibrated for personnel exposures. We can however offer monitoring for dosimeters that are in a much higher range so long as you identify them, when known, as high exposures. We have specialty equipment that is calibrated for this type of reading. Our normal dose range for personnel dosimeters is from 1mrem to 1000Rem.
- c. For those employees that wear two dosimeters, above and below a lead apron, Landauer can apply an external dose calculation to indicate a more effective deep dose equivalent. This calculation is commonly referred to as the Webster calculation (EDE 1). We apply 5% of the collar dosimeter and 150% of the waist dosimeter. The individual dosimeter readings without the calculation are shown in the current period but the calculation is applied in their quarter to date, year to date, and lifetime exposures. We also support (EDE 2) where only one dosimeter is worn at the collar. In this case we apply 30% of the dose reading. Both calculations are optional reporting services that can be applied down to the participant level. Both services are applied, if requested, at no additional charge.

D. DOSIMETER SPECIFICATIONS

EXCEPTION - EXCEEDS SPECIFICATION – Landauer Luxel+ dosimeters in many cases exceed your specification as follows:

Luxel+ (Type P)

X-Ray/Gamma	>5 keV >1mrem reporting
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Beta	>150 keV - \approx 10 MeV >10mrem reporting
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Luxel+ (Type J)

X-Ray/Gamma	>5 keV >1mrem reporting
Beta	>150 keV - \approx 10 MeV >10mrem reporting
Fast Neutron	>40 keV - \approx 40 MeV >20mrem reporting

Luxel+ (Type T)

X-Ray/Gamma	>5 keV >1mrem reporting
Beta	>150 keV - \approx 10 MeV >10mrem reporting
Neutron	>0.250 eV - \approx 40 MeV >20mrem reporting

E. SHIPMENT SPECIFICATIONS**2.EXCEPTION**

Luxel+ holders do not contain filters. All filters are within the dosimeter itself. The holder is only a mechanism to hold the dosimeter onto the body. The dosimeter can be used without the holder. Some manufactures more recent lead aprons provide a small slot to accommodate the Luxel+ dosimeter since it is so widely utilized. There are multiple holder clip formats available to accommodate your custom needs upon request.

5.CLAIRIFICATION - (Sample exposure report enclosed within "Sample Reports" booklet)

- 6 a. **CLAIRIFICATION** - Landauer provides a complete web based dosimetry service called LISN (Landauer Interactive Service Network). It includes all administrative functions such as additions, changes, deletes, and reactivates. It also has full functional ALARA, History Browse functions, and unreturned dosimeter reports. Unreturned dosimeters may also be barcode scanned over the web to identify those missing. We also provide "Reports on the Web" so you may review exposure reports on line. (LISN Brochure is enclosed) To preview LISN and other Landauer online functions please visit our website at www.Landauerinc.com
- b. **CLAIRIFICATION** - All LISN functions permit you to export data in XML, Excel, or in a PDF files.
- c. **EXCEPTION** – Annual Form 5 Reports are not available at this time from our web based system. You may however produce them from our RadPro dosimetry management system should you choose to utilize that particular software.